How to Manage Burns in Primary Care

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SUMMARY

Burns are common injuries; more than 200 000 occur in Canada annually. Nearly all burn injuries can be managed on an outpatient basis. Appropriate treatment depends on burn depth, extent, and location. Special types of burns, such as chemical, tar, and electrical injuries, need specific management strategies. Prevention through education is important to reduce the incidence of burns.

RÉSUMÉ

Les brûlures sont courantes. On en compte plus de 200 000 par année au Canada. On peut traiter en clinique externe la plupart de ces blessures. Le traitement approprié est fonction du degré de la brûlure, de son extension et de sa localisation. Certains types spécifiques de brûlures, telles les brûlures chimiques, électriques et par goudron, nécessitent des stratégies thérapeutiques spécifiques. L'éducation préventive est importante pour réduire l'incidence des brûlures.

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A BURN IS ONE OF THE MOST devastating injuries a patient can experience. Burn injuries are second only to motor vehicle accidents as accidental causes of death. Multiple organ systems (skin, lungs, eyes, mucous membranes, gastrointestinal, renal, and immunological) are affected by serious burns, and patients suffer loss of function and disfiguring scars.[1,2]

Approximately 200 000 Canadians sustain a burn injury each year; 95% of these injuries can be treated on an outpatient basis.[3] Both undertreatment and overtreatment of minor burns results in pain and prolonged morbidity, infection, delayed wound healing, and poor functional and aesthetic results. The main goals of managing outpatient burns are to facilitate patient comfort, wound healing, and rapid rehabilitation.[4]

Epidemiology

In Canada and the United States, approximately 1% of the population is seen by a physician each year for a burn injury.[2] Smoke inhalation is the most common cause of death from major burns and occurs in 30% of such injuries. If the patient survives the first few days, the most common cause of death becomes infection, including burn wound sepsis and pneumonia.[1,2]

Although building fires account for less than 5% of burn admissions, they are responsible for 45% of burn deaths.[5] Common causes include smoking, electrical sources, cooking, local heating units, and arson. In the United States fires due to smoking are responsible for 5000 burns, 2300 deaths, and $300 million (US) in property damage each year.[6] Two thirds of fire deaths occur at home, and 50% of these fires are caused by children.[6] The incidence of fire injury is highest among those 18 to 25 years, but deaths from burn injury are more common among the very young and the elderly.[6] Burn injuries to children are often caused by scalds, whereas among teens and adults flammable liquids are more often the culprits.[5]

The mortality in 1964 of a 50% body surface area burn was more than 50%; by 1984 this was reduced to less than 10%. The most significant advance in burn care responsible for this decrease was likely the development of specialized burn care teams and burn centres.[5,7]

Evaluating the burn injury

A patient with a burn injury usually presents to the emergency department, and

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the status of airway, breathing, and circulation need to be assessed immediately. The acute management of a major burn is beyond the scope of this article, but there are many excellent reviews on the subject.[7-9] The severity of the burn must then be evaluated based on extent, depth, location, origin, patient's age, and comorbidity. This evaluation helps physicians determine whether to admit a patient to hospital or to treat as an outpatient.

Extent. The percentage of body surface area (BSA) burned is used to describe the extent of a burn injury. First-degree burns are not included when calculating BSA. To estimate the BSA involved in a burn injury, the "rule of nines" can be used for patients older than 10 years (*Figure 1*). It is also useful, especially for patchy burns, to remember that the patient's palm is 1% of the BSA.[2,3] Children younger than 10 years have different body proportions, so a Lund-Bowder chart should be used to calculate BSA.[10] These charts are available in most emergency departments and are also available for adults.

Depth. The depth of a burn is determined by temperature and duration of exposure. The skin can tolerate temperatures up to 40°C for long periods. Above this temperature, tissue destruction from protein coagulation begins, and it increases logarithmically with increasing temperature.[7] Burns are categorized as first-, second-, third-, or fourth-degree (*Table 1*).

First-degree burns: Tissue destruction involves only the epidermis. There is typically pain and erythema that blanches to pressure but no blister formation. Systemic response is minimal or absent, and healing occurs in 3 to 4 days. First-degree burns are usually caused by sun (ultraviolet light) exposure, mild scalds, or flash burns from an explosion.[2-4]

Second-degree burns: Second-degree (partial thickness) burns are subdivided into superficial partial thickness and deep partial thickness. Superficial partial thickness burns (*Figure 2*) involve the epidermis and superficial dermis. Blister formation is common; if the blisters rupture or are removed, the wound is moist and erythematous. The burn is painful with intact sensation in the wound. These burns heal by epithelialization from the adjacent unburned skin and intact skin appendages (hair follicles, sebaceous and sweat glands) in 2 to 3 weeks with minimal scarring. The usual causes of superficial partial thickness burns are scalds, flash burns, or brief contact with hot objects.[2-4]

Deep partial thickness burns involve the epidermis and most of the dermis. Some skin appendages and nerve endings are left intact. These burns often appear mottled with waxy white areas and red elements representing coagulated dermal vessels. The surface is dry with reduced sensation. Healing usually occurs spontaneously in 4 to 6 weeks; however, the epidermis is often unstable, leading to repeated breakdown and hypertrophic scarring. Contracture formation around joints is common. It is often difficult to distinguish deep partial thickness from full thickness (third-degree) burns initially. Two or 3 days sometimes elapse before the burn "declares" itself. These burns are commonly caused by flame, scalds, or hot grease.[2-4] All large second- and third-degree burns have systemic effects, which are important for patient management but beyond the scope of this article.

Third-degree burns: Third-degree or full thickness burns (*Figure 3*) involve the epidermis and full thickness of the dermis, and varying amounts of the subcutaneous tissue. The wound appears white, tan, gray, brown, or red, and thrombosed blood vessels can be seen. The destroyed elasticity of the dermis gives the burn a leathery texture, and the wound is anesthetic. Third-degree burns are usually caused by flame, electricity, chemicals, or prolonged contact with a heat source.[2-4]

Fourth-degree burns: These burns are the same as third-degree burns, but involve deep structures, such as tendon, muscle, or bone.

Location. When evaluating a burn and deciding whether it merits admission to hospital, several critical areas of the body must be considered. These include the face, ears, eyes, hands, feet, and perineum. Burns that encircle a limb, the neck, or the chest must also be specially evaluated. The eschar (dead, coagulated skin) from a third-degree burn can cause vascular insufficiency or respiratory compromise.

Figure 1. **Rule of nines for estimating body surface area burned:** *Each upper limb is 9%, each lower limb 18%, the head and neck 9%, the back and buttocks 18%, and the chest and abdomen 18%.*

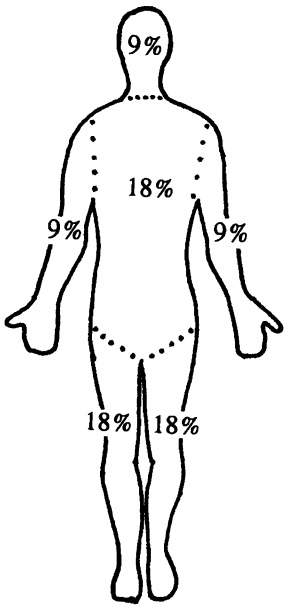

Table 1. **Burn depth evaluation**

DEPTH	ANATOMY	APPEARANCE	SENSATION	SCARRING
First-degree	Epidermis only	Erythema that blanches with pressure	Intact; burn mildly painful	None
Second-degree				
• Superficial	Epidermis and superficial dermis; skin appendages intact	Blisters moist and erythematous underneath; blanches with pressure	Intact; burn painful	Unusual
• Deep	Epidermis and most of dermis; most skin appendages destroyed	Whitish with red elements, dry, waxy; does not blanch	Decreased; burn less painful	Usually occurs; could be hypertrophic; contractures
Third-degree	Epidermis, all of dermis, and skin appendages destroyed	White, red, tan, charred, thrombosed vessels; dry and leathery; does not blanch	Anesthetic; burn wound not painful	Present; could be hypertrophic; contractures
Fourth-degree	Same as for third-degree with tendon, bone, or muscle involved	Same as for third-degree	Same as for third-degree	Same as for third-degree

The burn eschar is inelastic and causes constriction as the surrounding injured tissue becomes edematous. If this occurs, immediate referral for surgical evaluation is indicated.[2,4,7]

Origin. Several types of burns require special consideration. Electrical burns can appear minor on the surface; however, often underlying muscle, nerve, and blood vessel damage requires expert evaluation. Cardiac arrhythmias can occur during the first 72 hours after injury and should be monitored.[2,11] Chemical burns also can be more severe than expected from initial examination. These burns occasionally require very specific treatment for local and systemic disease.[2,12] A final concern is whether the burn was an intentional injury. If child abuse or any other type of assault is suspected, the proper authorities should be involved and admission could be warranted. If the injury was self-inflicted, the patient requires psychiatric evaluation.

Age. Patients who are either very young or elderly need special consideration during burn evaluation. These age groups suffer a greater mortality than other age groups with similar burns.[6] Also, the social circumstances of the patient often play an important role in his or her ability to cope at home with the injury.

Comorbidity. Other injuries occurring at the time of the burn and concurrent unrelated illnesses should both be considered. Burn patients must always be evaluated carefully for the possibility of inhalation injury, especially if they have been trapped in an enclosed space, such as a building or car, during a fire. Patients should be examined for singed scalp hair, nasal hair, or beard; soot on the mucous membranes; and carbonaceous sputum. The patient could have a cough, wheeze, or difficulty breathing or swallowing.[2] Respiratory distress most often develops several hours after the burn and, if present immediately, can represent carbon monoxide poisoning or constricting eschar around the chest or neck.[7] Any suggestion of inhalation injury is reason to admit a patient to hospital for observation.

Other trauma often accompanies burns and must be searched for. Falls are common in building fires and electrical burns, and spinal injury or fractures should be ruled out. Tetanus status must be ascertained, and toxoid with or without tetanus immune globulin should be given when indicated. The patient's medical history, including cardiovascular, pulmonary,

renal, and endocrine disease, must be assessed for how it could affect current management. All medications and allergies should be noted.

Whom to admit. Once this evaluation is complete, a treatment plan is formulated. The American Burn Association's grading system for determining injury severity can be used as a guide when deciding whether a patient requires admission. Second-degree burns of greater than 15% BSA in adults or 10% in children, and third-degree burns greater than 2% BSA in either should be admitted. Special consideration is also given to patients who do not necessarily meet these requirements but have a burn in a critical area, are at the extremes of age, have significant comorbidity, or have special social circumstances.[4]

Treatment

The initial management of a burn is always to remove the source of injury (extinguish flames, remove source of heat or electricity, wash off chemicals). Burn wounds should be cooled to stop progression of the burn and to decrease pain. This is done by submerging the burn in cool water or applying cool saline compresses, remembering to avoid hypothermia in patients with large burns.[2,3,13] Constricting clothing and jewelry should be removed, the burn covered with clean cloth or gauze, and the patient transported to an appropriate centre for evaluation of the burn.

Depth of burn. *First-degree burns:* First-degree burns require minimal treatment. A mild oral analgesic and moisturizer to be applied to the burn are usually sufficient. There is no benefit to applying a dressing.[2]

Second-degree burns: All partial thickness burns should be cleansed using water and a mild soap after the patient has been given adequate analgesia. The burn should then be debrided, removing necrotic tissue, ruptured blisters, and blisters filled with cloudy fluid.[13] Managing clean intact blisters is controversial,[4] but we suggest leaving these alone unless imminent rupture appears likely.

Topical chemoprophylaxis should not be used routinely on small burns but is useful for large burns to reduce the incidence of burn wound sepsis. The most common agent used is silver sulfadiazine (SSD) applied twice daily, which has broad antimicrobial coverage and penetrates burn eschar. However, allergic reactions to the sulfa component can occur; it is irritating to mucous membranes; it can breed resistant strains of bacteria; and it is contraindicated during pregnancy and for infants younger than 2 months. Use of SSD has also been shown to delay wound healing, decrease leukocyte chemotaxis, and cause a transient leukopenia in 10% of cases.[2,3,6]

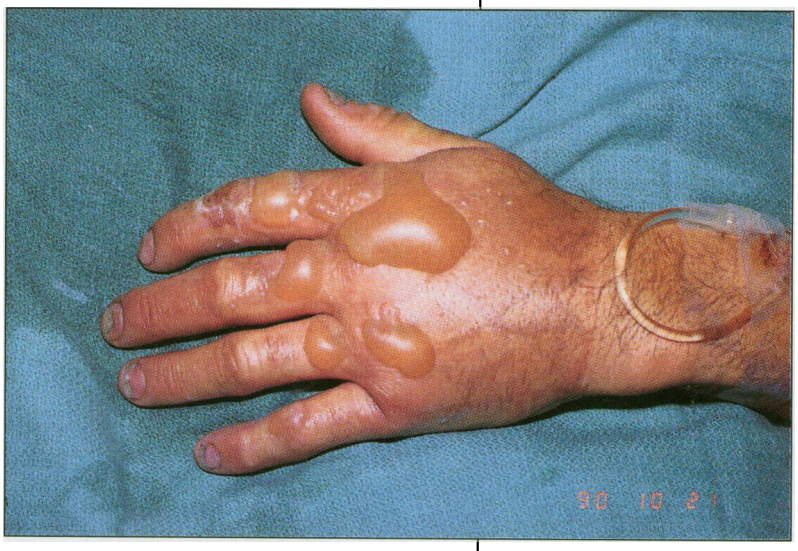

Figure 2. **Superficial partial thickness (second-degree) burn to a hand:** *The wound is moist and erythematous with blister formation.*

A dressing is then applied. The burn dressing provides a clean and moist environment, which promotes healing, reduces trauma to the wound, allows drainage, and increases patient comfort. The first dressing layer consists of a petroleum jelly–impregnated nonadherent gauze (some authors suggest using a polymyxin B ointment in addition). A second layer of saline-soaked gauze to dry gauze and a final layer of bandage wrapping (being certain not to overconstrict) completes the dressing.[2,4]

The dressings should be changed twice daily for larger burns and daily for smaller burns. The dressings are removed after soaking in water. The burns are then washed gently with water and soap and patted dry with a clean cloth.

Dressing changes are done initially at the hospital, an outpatient clinic, or the family physician's office, depending on the extent of the burn and the patient's analgesia requirements. After some basic teaching, the patient, the patient's family, or a visiting nurse can often change dressings at home.[2]

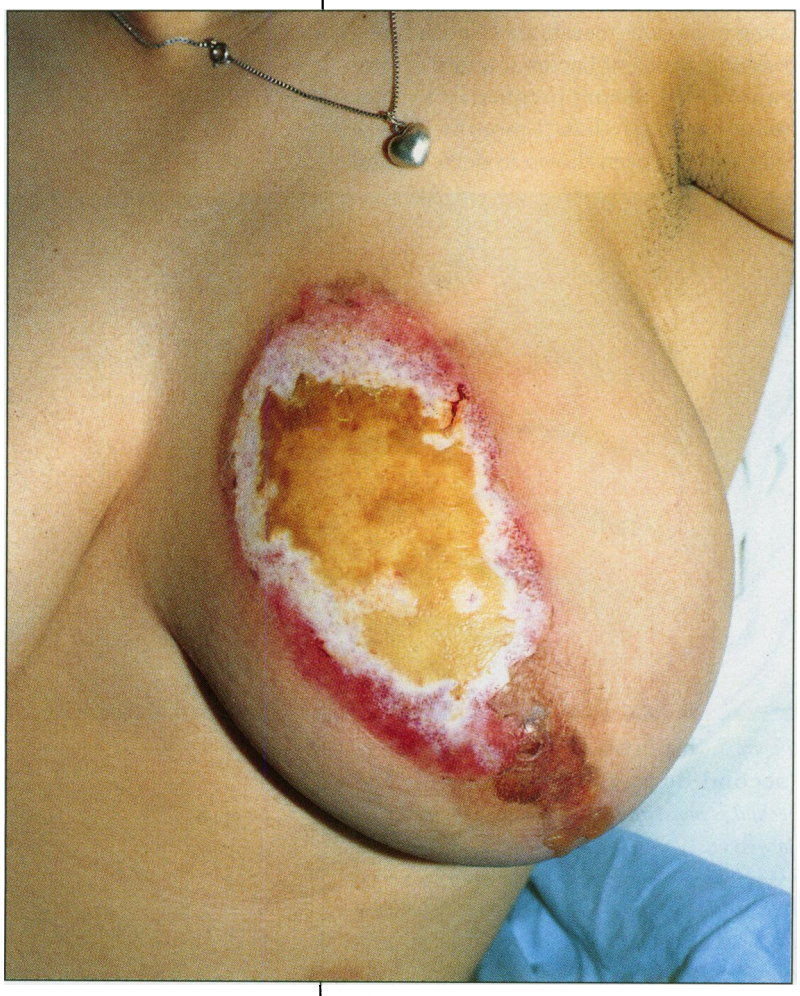

Figure 3. **Full thickness (third-degree) burn to a breast:** *Tan, leathery eschar covers the wound.*

Range of motion exercises should be started early for any burn involving a joint area, and referral to a physiotherapist familiar with burn rehabilitation is often indicated.[4] Systemic antibiotics should not be given routinely except when endocarditis prophylaxis is required. The wounds should be closely monitored for signs of infection. Initially Gram-positive organisms (especially *Streptococcus* species) tend to proliferate in the burn wound, but by day 5 Gram-negative organisms (especially *Pseudomonas aeruginosa*) predominate.[2] If burn wound infection is suspected, it is best managed by referral to a plastic surgeon.

Dressings are continued until full healing occurs. After this, moisturizers are applied (burned skin tends to be dry and itchy for several months), and the patient is instructed to keep the burned area out of the sun for 1 year.[3,4] If the wound does not appear to be healed by 3 weeks after the injury, referral to a plastic surgeon is indicated. Excision and skin grafting will likely be necessary to avoid delayed wound healing, wound breakdown, and hypertrophic scarring.[3,4]

Third-degree burns: Third-degree burns are initially treated like partial thickness burns. The wound is cleansed and debrided, and dressings are changed twice daily using SSD cream. Spontaneous healing of third-degree burns is slow and functionally and aesthetically inadequate, so all but the smallest (less than 2 cm) wounds require excision and grafting by a plastic surgeon.[3,4]

Fourth-degree burns: These are managed identically to third-degree burns with early referral to an experienced burn surgeon.

Critical areas. Burns to critical areas of the body usually require referral for expert management.

Face: Burns to the face often become very edematous after 24 hours. These burns should not be treated with SSD or dressings but rather with twice daily washing and application of polymyxin B ointment.[3,4]

Ears: Superficial burns to the ears should be treated identically to burns to the face. Deeper burns require SSD or mafenide cream and dressings, avoiding any pressure over the burn that could lead to chondritis.[3,4]

Eyes: A fluorescein slitlamp examination should be done with a suspected eye injury. A minor burn will resemble an abrasion and should be irrigated and treated with antibiotic ointment and patching. Any injury not fully healed in 48 hours, or any major injury, should be referred to an ophthalmologist.[4]

Hands: Burns to the hands can easily cause vascular compromise, so encircling eschar must be attended to. The wounds should be treated as outlined above, depending on depth, and each finger must

be dressed individually to prevent maceration. The hand should be kept elevated to improve comfort, edema, and healing. Early range of motion exercises are vital, and referrals to a physiotherapist and occupational therapist are often indicated to maintain mobility. Splinting is required to prevent contracture formation.[3,4]

Feet: These injuries should be treated much like hand burns. Early ambulation is encouraged after healing, with a tensor bandage applied to the feet.[3,4]

Perineum: Burns to the perineum should be treated as outlined above, depending on depth. It is often wise to observe these patients for 48 hours for the development of urinary obstruction secondary to edema, which can require catheterization.[4]

Special burns. *Chemical burns:* All chemical burns should be irrigated with water or saline for at least 20 minutes. Neutralizing agents should be avoided because they produce exothermic reactions, which can worsen the burn. The burns are then treated as outlined above, keeping in mind possible systemic toxicities, such as phenol burns causing renal failure. Hydrofluoric acid burns require additional subcutaneous injections of 10% calcium gluconate around the burn to precipitate the fluoride ion. This limits progression of the burn and decreases pain significantly.[3,12]

Tar burns: Tar covers and adheres to the burn wound. Removal is very traumatic to the wound and should be avoided, but the tar should be cooled immediately with water. Application of copious amounts of polymyxin B ointment or special industrial solvents will emulsify and remove the tar over several days.[3,12]

Electrical burns: The first step in managing an electrical burn is safe removal of the patient from the source of current and resuscitation if injuries are life-threatening. These patients should be monitored for particular problems, such as arrhythmias or compartment syndromes requiring fasciotomies. Renal failure (acute tubular necrosis) from myoglobinuria can occur, requiring high volumes of IV fluids and occasionally mannitol or sodium bicarbonate diuresis. Entrance, exit, and arc (across the axilla, antecubital fossa, or popliteal fossa) wounds must be searched for. Often the burn injury to the skin is quite small; however, there can be a large underlying area of necrotic muscle and bone, requiring urgent surgery. Associated injuries are common and include fractures, neuropathies, central nervous system symptoms, and vascular injury.[11,13]

Scarring. All burns should be observed for at least 6 weeks for hypertrophic scarring. These red, thick, raised, and often itchy or painful scars are common in deep partial thickness and full thickness burns. Management of hypertrophic scars consists of compression garments for 6 months to 2 years and occasionally steroid injections into small scars. Scarring across joints can cause serious contractures. These are best managed by referral for splinting and surgical evaluation.[3,4]

Education and prevention

The optimal management of burn injuries is to prevent their occurrence. Long exposure to sunlight should be discouraged and the use of sunscreen encouraged. Electrical appliances should be kept in good condition, with inspection and proper maintenance when indicated.

If there are children in the house, the water heater should be set at a temperature no higher than 50°C, and all hot pots and pans should be out of reach with handles turned inward. Children must be taught not to play with lighters, matches, or other potential sources of fire.

All homes and buildings should be equipped with functioning smoke detectors, and smoking in bed should be strongly discouraged. Flammable liquids, such as gasoline or lighting fluid, should never be added to warm machinery, burning fires, or hot barbecues. By educating the public with simple strategies such as these, a great deal of human morbidity and property damage can be avoided.[2,6] ■

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